In the Claims

A complete listing of the claims follows:

1. (Currently amended) A radial reactor for catalytic reaction of gaseous or liquid feed streams comprising

a conventional radial reactor assembly containing a vertical, annular catalyst bed, and

a ring-shaped, vertical layer of material contained within the catalyst bed, wherein the material comprises an active catalyst material contained within a first ring-shaped, vertical layer of the catalyst bed and an inert material contained within a second ring-shaped, vertical layer of the catalyst bed, wherein the active catalyst material is contained within an outer, ring-shaped, vertical layer of the catalyst bed and the inert material is contained within an inner, ring-shaped, vertical layer of the catalyst bed.

2. Canceled

3. (Original) The radial reactor of Claim 1 wherein the layer containing the catalyst material is at least about 4 inches (10 cm) in thickness, when measured radially from a center of the radial reactor.

4. (Original) The radial reactor of Claim 1 wherein the layer containing the catalyst material is from about 6 to about 36 inches (15 cm - 90 cm) in thickness, when measured radially from a center of the radial reactor.

5. (Original) The radial reactor of Claim 1 wherein the layer containing the catalyst material is from about 6 to about 24 inches (15 cm - 60 cm) in thickness, when measured radially from a center of the radial reactor.

6. (Original) The radial reactor of Claim 1 wherein the inert material comprises an alpha alumina, ceramic material or a monolithic structure.

7. (Original) The radial reactor of Claim 1 wherein the overall thickness of the ring-shaped, vertical layer of material contained within the radial reactor is at least about 18 inches (45 cm).

8. (Original) The radial reactor of Claim 1 wherein the overall thickness of the ring-shaped, vertical layer of material is from about 18 inches (45 cm) to about 48 inches (120 cm).

9. (Original) The radial reactor of Claim 1 wherein the active catalyst material comprises a plurality of active catalyst products, at least two of which catalyst products have different performance characteristics.

10 - 13. Canceled

14. (Currently amended) A radial reactor for nonoxidative dehydrogenation of an alkylaromatic feed stream comprising

a conventional radial reactor assembly containing a vertical, annular catalyst bed and

a ring-shaped vertical layer of material contained within

the catalyst bed, wherein the material comprises a nonoxidative dehydrogenation catalyst contained within ~~a~~ an outer, ring-shaped, vertical layer of the catalytic material and an inert material contained within an inner ring-shaped, vertical layer of the catalyst bed.

15. (Original) The radial reactor of Claim 14 wherein the layer containing the catalyst material is at least about 4 inches (10 cm) in thickness, when measured radially from a center of the radial reactor.

16. (Original) The radial reactor of Claim 14 wherein the layer containing the catalyst material is from about 6 to about 36 inches (15 cm - 90 cm) in thickness, when measured radially from a center of the radial reactor.

17. (Original) The radial reactor of Claim 14 wherein the inert material comprises an alpha alumina or ceramic material.

18 - 25. (Canceled)

Claim Amendments

Claim 1 has been amended to incorporate the limitations of Claim 2 into Claim 1, whereby the annular catalyst bed is divided into an outer ring-shaped and an inner ring-shaped, wherein the outer ring-shaped vertical layer of the catalyst bed contains active catalyst material and the inner ring-shaped vertical layer contains an inert material. No new subject matter is introduced by

this Amendment as the applicants are incorporating the limitations of Claim 2 into Claim 1. Claims 10 through 13 are cancelled as they are duplicates of some of the claims, as amended. A minor amendment is made to Claim 14 pursuant to the suggestion of the Examiner. Claims 18 through 25 are canceled as they are directed to non-elected claims.

Drawings and Specification

The applicants will again review the drawings and specification once all claims are in an allowable condition.

Discussion

The USPTO rejected Claims 1 and 9 under 35 USC 102(b) as being anticipated by Rogers, et. al., U.S. Patent No. 3,620,685. The USPTO has also rejected Claim 1 under Waddill, U.S. Patent No. 3,249,405. Finally, the USPTO rejected Claims 2 - 8 and 10 - 17 under 35 USC 103(a) as being obvious over Rogers, et. al. The applicants respectfully traverse each of these rejections.

The applicants have discovered a new and novel structure for a radial reactor, particularly for use for an nonoxidative dehydrogenation reaction. The catalyst bed, which is contained within this unique radial reactor, contains an inner and an outer ring-shaped vertical layer, wherein the inner vertical layer is filled with an inert material and the outer vertical layer is

filled with an active catalyst material. In a particularly preferred embodiment for use for a nonoxidative dehydrogenation feedstream, a nonoxidative dehydrogenation catalyst is placed within the outer ring-shaped vertical layer of the catalyst bed and an inert material is placed within the inner ring-shaped vertical layer. The applicants have discovered that by this particular placement of the catalyst and inert material in a radial reactor catalyst bed, substantial and surprisingly improved performance is achieved over catalysts contained in prior art, conventional reactors.

Analysis of References

Rejections under 35 USC § 102 based on Rogers, et. al. and Waddill

The amendments that have been made to the claims of the application overcome the rejections based on Rogers, et. al. and Waddill. The applicants have amended Claim 1 to incorporate the limitations of Claim 2 into Claim 1. Rogers, et. al. and Waddill were only cited as rejecting Claims 1 and 9 based on 35 USC § 102. As Claim 9 has been canceled and Claim 1 has been amended to incorporate the limitations contained in Claim 2, which was not rejected based on Rogers, et. al. or Waddill, the rejections based on those references have been overcome. As a result no discussion of Waddill is necessary, although the applicant reserves the right to comment on this reference at some later time, if necessary. The

applicants, therefore, respectfully request withdrawal of the rejections under 35 USC §102 based on Rogers, et. al. and Waddill.

Obviousness Rejections Based on Rogers, et. al.

The applicants respectfully assert that the rejection of Claims 2 - 8 and 10 - 17 under 35 USC §103 should also be withdrawn.

The USPTO has asserted that *prima facie* case of obviousness has been established to reject these claims. The USPTO has established a three step process for proving *prima facie* obviousness. The first step requires the Examiner to set forth the differences in the claim over the reference or references. The second step requires the Examiner to set forth the proposed modification of the reference(s) which would be necessary to arrive at the claim's subject matter. The third step requires the Examiner to explain why the modification would be obvious. MPEP 2142.

In the Office Action the USPTO acknowledges that Rogers, et. al. "does not explicitly disclose that the catalyst [must be] disposed within the outer layer and the inert [must be] disposed within the inner layer...". Rather the USPTO asserts that "...Rogers, et. al. states in general that one layer is a catalyst layer and the other layer is an inert layer, and therefor encompasses the structure of instant Claim 2." The USPTO further

states that such choice would have been merely be a "design choice" and "...well within the knowledge of one skilled in the art ... since it has been held that rearranging parts of an invention involves only routine skill in the art." Page 4.

The applicants respectfully suggest that this particular design of the invention is not suggested or made obvious by the disclosure of Rogers, et. al. The invention, as now claimed, requires that the outer layer of the catalyst bed contain the active catalyst material and the inner layer contains the inert material. A person skilled in the art reviewing the design of Rogers would not have designed a radial reactor with this arrangement. In fact, if the Rogers, et. al. reactor was designed with this structure, it would perform less well than a radial reactor which contained no inert material at all. As shown in the sole figure of Rogers, et. al., the flow pattern of the gas stream is from the outside to the inside of the catalyst cylinders 4, 6 and 8. Thus, if the active catalyst was contained in the outside layer (designated by No. 5), and the inert material was on the inner layer (designated by No. 7), then the hot gas would immediately contact the catalyst layer prior to contacting the inert layer. This flow pattern would result in many of the adverse consequences which are discussed throughout the application, such as an increase in pressure drop, an increase in by products and a reduction in performance than if the location of the catalyst and

inert material were reversed. A person skilled in the art would never use this claimed arrangement as it would produce a less useful radial reactor. Accordingly, the modification suggested by the Examiner would not be adopted.

In contrast, the invention is premised on a particular flow pattern that is present in the radial reactor of the invention as shown in Figure 1 where the gas stream flows into the center of the radial reactor, passes through the inner and then the outer layer of the catalyst bed, and then flows upward around the outside edge of the catalyst bed and out the top of the reactor. This is the opposite flow pattern to that disclosed in Rogers, et. al.

This difference is not without a significant distinction that is not obvious from a review of Rogers, et. al. The USPTO has acknowledged that Rogers, et. al. does not teach a preference for the placement of the active catalyst material.

In contrast, the applicant have discovered that the combination of an inert material, contained in the inner layer, with active catalyst material placed in the outer layer of the radial reactor produces a highly efficient and far preferable catalyst arrangement than is taught or suggested by Rogers, et. al. In the arrangement, as claimed, for nonoxidative dehydrogenation of an alkyl aromatic feedstream, the particular placement results in higher activity of the catalyst when the catalyst is placed in the outer layer. (See page 15, lines 10 - 17.) In addition, by placing

the catalyst in the outer layer and the inert material in the inner layer, the overall initial surface area of the catalyst material that is disposed to the hot, preheated feedstream is enhanced over a situation where the inert material was on the outer layer. (See page 15, lines 18 through page 16, line 9.) The particular arrangement also results in a greater volume of catalytic material. (See page 16, lines 10 -26.) Other improvements in the performance are discussed at page 17, lines 1 - 9, where there is greater physical stability, a reduction in initial pressure drop and a reduction in the increase in pressure drop with the aging of the catalyst while on-line. Further, there is a reduction in unwanted by-products as discussed at page 17, lines 10 through page 18, line 10.

As a result of all of these improvements, the arrangement of the catalyst and an inert material results in a surprising improvement over what would be anticipated by the disclosure of Rogers, et. al.

Applicants respectfully assert that the USPTO has failed to satisfy the third step necessary to establish *prima facie* obviousness. <u>This third step requires the USPTO to identify where in Rogers, et. al. there is a motivating suggestion to choose the particular structure for the catalyst bed</u>. A person skilled in the art reviewing the disclosure of Rogers, et. al. is certainly <u>not</u> encouraged to even use an inert material, and if an inert material

is used, there is no encouragement as to the placement of that inert material. Finally, because of the flow pattern of the gas feedstream in Rogers, et. al., the placement of the catalyst material in the outer layer and inert material in the inner layer would result in a less efficient radial reactor than the applicants' reactor where the pattern of flow into gas is the opposite. Accordingly, no motivation is present to a person skilled in the art to adapt the particular arrangement of the catalyst beds as claimed in all claims of the application. In In re Jones, 958 F.2d. 347, 21 USPQ 2d 1941, 1944 (Fed. Cir. 1992), the Court stated that "[t]he prior art must provide one of ordinary skill in the art the motivation to make the proposed... modification needed to arrive at the claim compound." The USPTO has failed to disclose any suggestion or motivation in Rogers, et. al. to arrange the catalyst beds in the manner now claimed, especially with the flow pattern of the gases that is required by Rogers, et. al.

Moreover, the USPTO has failed to prove that the use of a catalyst material along with an inert material within the catalyst bed in the particular arrangement that is now claimed in the claims of the application is a "desirable" modification. The "desirability" of the design motivation must also be proved to established *prima facie* obviousness.

> The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. In re Fritch, 922 Fed. 2d. 1260, 23 USPQ 2d, 1780, 1783-84 (Fed. Cir. 1992).

In addition the USPTO has failed to show that the motivating suggestion to arrange the active catalyst in the outer layer and an inert material in the inner layer, which is not disclosed or suggested by Rogers, et. al. is "explicit" and not merely a vague reference to a possible modification.

> ...The invention can not be found obvious unless there was some explicit teaching or suggestion in art to motivate one of ordinary skilled or combined elements so as to create same invention. Winner Internationality Royalty Corp v. Wang, 48 USPQ 2d. 1139, 1140 (D.C.D.C. 1998) (Emphasis supplied)

There is no teaching or motivation within Rogers, et. al. that it would be preferable to arrange the catalyst within the catalyst bed in the manner now claimed. In fact, the inherent teaching is that this would produce a less favorable arrangement of the catalyst. Thus, there is clearly be no "explicit" teaching of this arrangement.

As a result, the USPTO has failed to prove *prima facie* obviousness of the invention over by Rogers, et. al.

CONCLUSION

Based on the amendments to the claims and the discussion of Rogers, et. al., the applicants believe that all claims of the application are now in condition for allowance and request that a Notice of Allowability be issued. If you have any questions concerning this application or any of the remaining claims, please contact applicants' counsel.

Respectfully submitted,

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